Forces and Motion

8-5 The student will demonstrate an understanding of the effects of forces on the motion of an object. (Physical Science)

8-5.1 Use measurement and time-distance graphs to represent the motion of an object in terms of position, direction, or speed.
Taxonomy level: 3.2-B Apply Conceptual Knowledge

Previous/Future knowledge: Students have been introduced to the concept of motion in terms of speed and direction in 3rd grade (3-5.2) and to position, speed, and direction in 5th grade (5-5.2). 5th grade students constructed a line graph (5-1.5) with the proper placement of the variables, as well as used a graph to illustrate motion (5-5.5). Students will further develop the concept of measuring and graphing motion using equations in high school Physical Science (PS-5.6).

It is essential for students to know that *motion* occurs when there is a change in position of an object with respect to a reference starting point. The final position of an object is determined by measuring the change in position and direction of the segments along a trip. The following terms are used to describe and determine motion:

Position
- *Position* is the location of an object.
- An object changes position if it moves relative to a *reference point*.
- The change in position is determined by the distance and direction of an object's change in position from the starting point (*displacement*).

Direction
- *Direction* is the line, or path along which something is moving, pointing, or aiming.
- Direction is measured using a reference point with terms such as up, down, left, right, forward, backward, toward, away from, north, south, east, or west.

For example, given the following data table, determine the change in the object's position based on its final position, distance, and direction, from a starting point.

Segment	Distance (m)	Direction
X	10	East
Y	7	North
Z	10	West

- Draw a line to scale representing 10 meters in an easterly direction.
- At the end of that line, draw a line representing 7 meters in a northerly direction.
- From the end of the second line, draw a line representing 10 meters in a westerly direction.
- Connect the end of the third line to the starting point.
- Measure the distance and direction from the starting point to the end of the third line.
- The position at the end of the trip is 7 meters north of the starting point.

Motion can also be described by the relationship between distance an object travels and the period of time it travels. This measurement of motion is a rate.

Forces and Motion

8-5 The student will demonstrate an understanding of the effects of forces on the motion of an object. (Physical Science)

Speed

- *Speed* is a measure of how fast something moves a particular distance (for example, meters) over a given amount of time (for example, seconds).
- Therefore, speed is the rate of change of the position of an object, or how far something will move in a given period of time.
- Speed does not necessarily mean that something is moving fast.

NOTE TO TEACHER: Calculations for speed will be done in the next indicator (8-5.2).

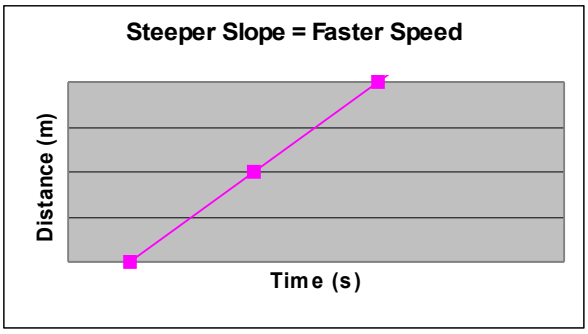
It is essential for students to use (construct and interpret) a distance-time graph to represent the motion of an object in terms of speed. Students should graph objects moving in only one direction away from the reference point (starting point).

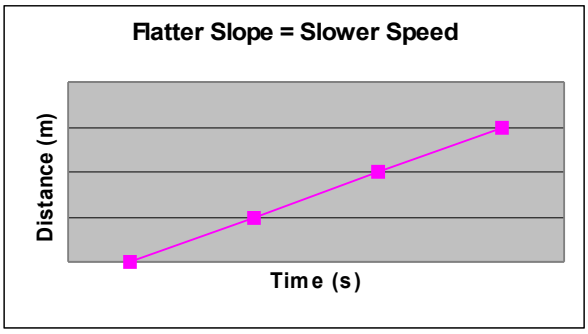
Distance-Time Graph

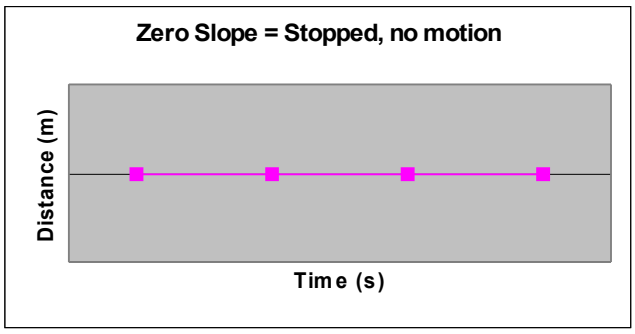
- A graph that can be used to represent how both speed and distance change with time.
- For this type of graph, time (the independent variable) is plotted on the x-axis and the distance (the dependent variable) is plotted on the y-axis.

Speed

- The slope of the line can tell the relative speed of the object.
- When the slope of the line is steep, the speed is faster than if the slope were flatter.
- When the slope of the line is flatter, the speed is slower.
- When the slope of the line is horizontal to the x-axis, the speed is zero (the object is not moving). For example:







Forces and Motion

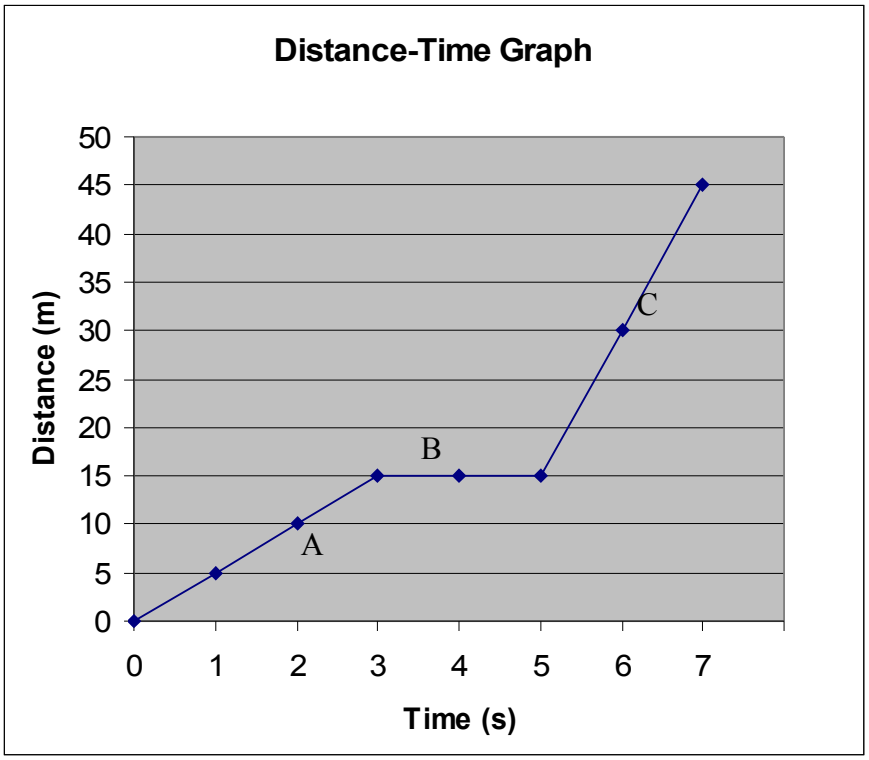
8-5 The student will demonstrate an understanding of the effects of forces on the motion of an object. (Physical Science)

NOTE TO TEACHER: Classroom experiments should be designed so that time is being manipulated (the independent variable) and distance is the dependent variable.

Data can be represented in a table. For example:

Time (s)	Distance (m)
0	0
1	5
2	10
3	15
4	15
5	15
6	30
7	45

This data can then be represented on a *distance-time graph*.



This distance-time graph can then be used to describe the speed of the object. For example, the speed of segment A is slower than segment C. The speed of segment B is zero, the object is not moving.

Forces and Motion

8-5 The student will demonstrate an understanding of the effects of forces on the motion of an object. (Physical Science)

It is not essential for students to know that speed in a given direction is called velocity or that the rate of changing velocity is called acceleration. Students do not need to interpret distance-time graphs in terms of the direction or position of the object. Students do not need to calculate the slope of the graphs. Students do not need to address speed-time (acceleration) graphs.

Assessment Guidelines:

The objective of this indicator is to *use* measurements and time-distance graphs to represent motion of objects in terms of position, distance, or speed; therefore, the primary focus of assessment should be to apply measurement and graphing skills to demonstrate the motion of objects in terms as listed in the indicator. However, appropriate assessments should also require students to *recognize* the variables (position, direction, speed) of motion; *interpret* the motion of an object from data on a graph; *match* a data table with its appropriate motion graph; *compare* faster and slower speed using the slope of a graph; or *represent* the motion of an object (with respect to a reference point) with a scale drawing using appropriate terms for position and direction.